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Can the Backlog Benefit From the Personnel System  
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**6. AUTHOR(S)**

Lt Col Peter R. Livingston  
Ms Jacqueline A. McClaskey

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The Air Force, like the rest of the Department of Defense, has a backlog of personnel awaiting a Top Secret security clearance. Since Top Secret clearances are costly in terms of both time and money, the goal of this study was to reduce the number of Top Secret clearances requested without changing the underlying requirements for the positions. This study was based on the hypothesis that changing the personnel assignment policy could reduce the number of new clearances requested each year. Statistical analysis was used to determine whether the assignment process currently considers Top Secret clearance status in assigning personnel to Top Secret authorizations. The study output developed several options to reduce the number of new clearances requested. However, further analysis showed that such consideration alone would not sufficiently alleviate the problem.

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***Security Clearance Backlog Analysis:  
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Lt Col Peter R. Livingston  
Air Force Studies and Analyses Agency  
1777 N. Kent St.  
Arlington, VA 22209  
Voice: (703) 696-8359  
Fax: (703) 588-0232  
[Peter.Livingston@pentagon.af.mil](mailto:Peter.Livingston@pentagon.af.mil)

Jacqueline A. McClaskey  
Air Force Studies and Analyses Agency  
1777 N. Kent St.  
Arlington, VA 22209  
Voice: (703) 696-8151  
Fax: (703) 588-0232  
[Lynn.McClaskey@pentagon.af.mil](mailto:Lynn.McClaskey@pentagon.af.mil)

Additional Team Members: Andrew Layman, Jody Miotke, Jennifer Verbeck, Erin Vickery, Chris Winkler

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**Abstract**

The Air Force, like the rest of the Department of Defense, has a backlog of personnel awaiting a Top Secret security clearance. Since Top Secret clearances are costly in terms of both time and money, the goal of this study was to reduce the number of Top Secret clearances requested without changing the underlying requirements for the positions. This study was based on the hypothesis that changing the personnel assignment policy could reduce the number of new clearances requested each year. Statistical analysis was used to determine whether the assignment process currently considers Top Secret clearance status in assigning personnel to Top Secret authorizations. The study output developed several options to reduce the number of new clearances requested. However, the study concluded that such consideration alone would not sufficiently alleviate the problem.

**20060323070**

## **Introduction**

Each initial Top Secret (TS) clearance investigation takes almost two years, costs thousands of dollars, and results in lost productivity since the individual under investigation is unable to perform their duties while waiting for the clearance. Total AF expenditures on security clearances are over \$100 million. An internal Air Force Studies and Analyses Agency (AFSAA) study found in 2003 that the average time to complete a Top Secret investigation was 481 days. Most often, the application is submitted only a few months before a new assignment begins, hence the person is working for a prolonged period with an inadequate clearance level. The Administrative Assistant to the Secretary of the Air Force requested AFSAA examine the costly and potentially inefficient method of selecting people submitted for security investigations.

This study focused solely on Top Secret security investigations and positions. Secret clearances were uninteresting from an analytical perspective because they are required for most USAF officer positions and the time and cost to obtain a Secret clearance was substantially less than that of a Top Secret. For this study, the terms "clearance" or "cleared" were associated with a Top Secret clearance and "non-cleared" or "no clearance" was any person or position associated with less than a Top Secret clearance, including a Secret clearance. Although there are several levels of Top Secret clearances, no distinction was made in this study between different types of Top Secret clearances.

The study addressed the following questions:

1. How many cleared jobs were filled with cleared personnel?
2. How many cleared jobs were filled with non-cleared personnel?
3. How important was possession of the appropriate clearance level in the assignment process?
4. What gains (in terms of monetary savings) could be achieved by more closely matching cleared jobs and personnel?

## **Data Overview**

In the AF, all funded authorizations (jobs) are listed in the Unit Manning Document (UMD), which provides information on the number of positions authorized as well as the clearance level required for those positions. Active duty personnel are contained in the Military Personnel Data System (MILPDS), which lists personnel (inventory) available for assignment. To connect the person identified in MILPDS to his/her job in the UMD, Job Identification Number and Tasked Personnel Accounting Systems (PAS) codes were used together to form a unique key. Results were aggregated by Air Force Specialty Code (AFSC), containing detailed categories describing the characteristics of a position such as career field, skill level, and special identifiers. For the purposes of this study, only the first three digits of the AFSC were used (AFSC3) which gave a general description of the career field (e.g. 11F is an AF officer code describing a Fighter Pilot). Both the UMD and MILPDS data used was dated 1st quarter 2005.

The first goal of the study was to examine how closely Top Secret personnel were matched to Top Secret authorizations.

	Total TS Authorizations	Total TS Personnel	% TS Authorizations filled by TS Personnel
OFFICER	32,095	37,780	57.4%
ENLISTED	49,103	53,004	50.8%

Table 1. Top Secret Authorizations vs. Personnel

Overall numbers in Table 1 show that the number of Top Secret officer personnel was greater than the number of Top Secret officer authorizations (e.g. 37,780 TS cleared officers to fill 32,095 TS officer positions). However, only 57.4% of those TS positions are filled by a person possessing a TS clearance. This shows a sizeable disconnect which was investigated further. Figures 1 and 2 below highlight the difference between Top Secret authorizations versus Top Secret personnel for officers and enlisted:

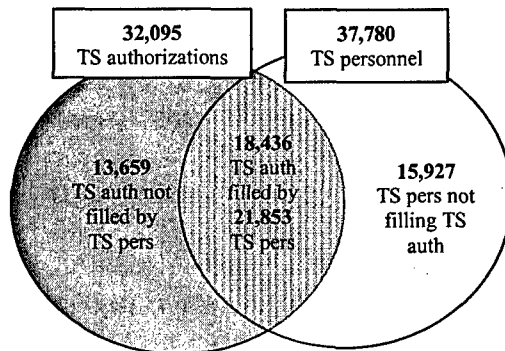


Figure 1. Officer

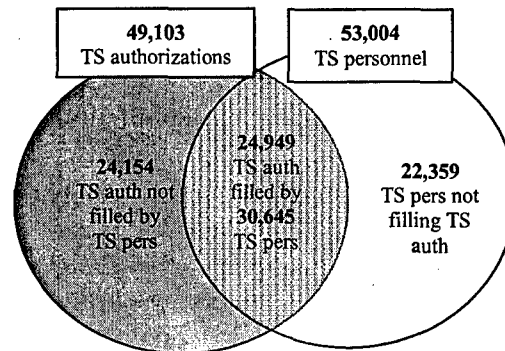


Figure 2. Enlisted

Friction in the assignment system sometimes caused authorizations to go unfilled even upon ready inventory. Additionally, there are some authorizations to which more than one person was matched. This was a problem primarily for those authorizations in the Student Training Pipeline, which did not greatly affect the outcome of this study. Therefore, for consistency, the study considered only matched personnel/authorization pairs.

### Initial Approach

A Markov chain analysis was initially considered for modeling the TS clearance backlog problem. Setting up the problem and defining the data requirements served as a good first step in defining the extent of the problem as well as helping to formulate an initial visualization of the clearance process and problem at hand.

The first step was defining the different attributes that an entity could have within the Markov model. Three binary attributes were identified and used to form the possible states in which an entity in our chain could exist. Some of the permutations were eliminated, as they did not fit into the context of the problem, leaving four possible states for an entity to exist in:

State	Has a TS Clearance?	Assigned to TS billet?	Awaiting a TS clearance?
S <sub>1</sub>	Yes	Yes	No
S <sub>2</sub>	Yes	No	No
S <sub>3</sub>	No	No	Yes
S <sub>4</sub>	No	No	No

Table 2. State Definitions for Entities in Markov Chain Model

A transition diagram was sketched in order to lay out the relationships between the four states and identify the necessary transition probabilities between those states. This diagram quickly translated into a comparable transition matrix and initial distribution vector where  $S_{n,t}$  is the population size of state  $n$  at time  $t$  and  $p_n$  is the probability of moving between the diagramed states.

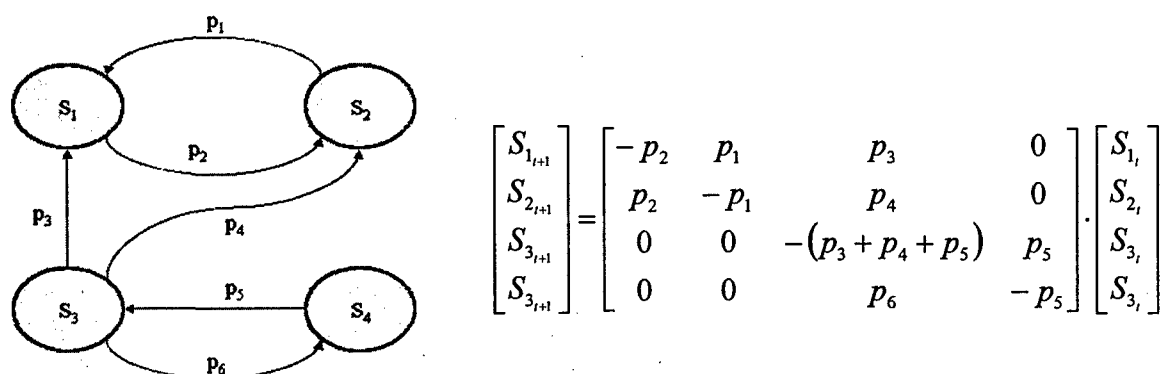
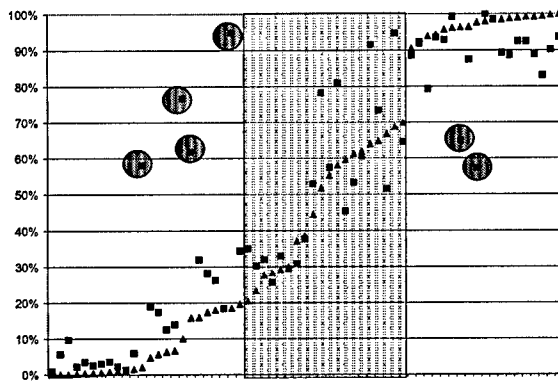


Figure 3. Markov Chain Diagram and Transition Matrix

However, as in the case with many studies, there were several data limitations. The only data available was a snapshot of the authorizations and the personnel assigned to them. The historical data necessary to approximate the transitional probability from one state to the next was not available and thus ended this analytic avenue, but not before helping to visualize the clearance process and better understand the nature of the problem.

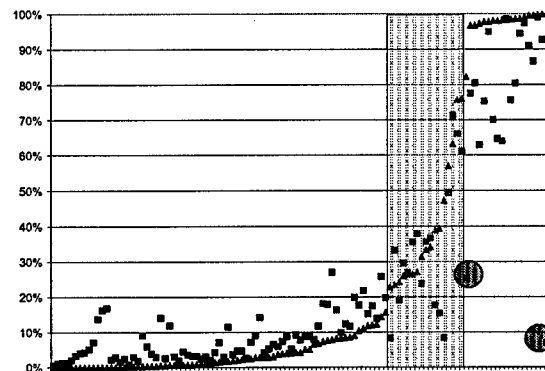
### Study Focus

Preferential placement of cleared people into cleared positions within career fields (AFSC3) will only be practical under certain conditions. First, the career field must have a variety of both cleared and non-cleared positions. Second, the career field has to be sufficiently large. Figures 4 and 5 show AFSCs ordered by the percent of authorizations requiring a Top Secret clearance.



▲ Top Secret authorizations

Figure 4. Officer



■ Top Secret personnel

Figure 5. Enlisted

\*\* Outliers (circled) were pulled out and analyzed separately.

The bands highlighted in Figure 3 and 4 were selected for this study for targeted assignments and were identified as those AFSCs where between 20% and 80% of authorizations require a Top Secret clearance. The absolute size of the population was also used as a limiting factor. Any AFSCs with a very small population (less than 500 authorizations for enlisted or less than 200 authorizations for officers) were excluded from further analysis. The list of AFSCs selected through this process is given in Appendix A.

As a result of the two limitations, those AFSCs in the highlighted regions shown in Figures 3 and 4 included only about 15% of the total AF population. This became a limiting factor on the potential savings.

Movement between career fields was one of the reasons that the low percent Top Secret authorization career fields had an abundance of cleared personnel with respect to their requirements and the high percent Top Secret authorization career fields had serious deficiencies. This was part of the reason why even though overall the number of cleared people was greater than the number of cleared jobs, they were not matched together well. Targeting assignments within career fields could not fix this issue and these effects served as another limitation for the gains that could be achieved via this strategy.

The outliers highlighted in Figures 3 and 4 were analyzed separately from the main study, although they are not of central interest here. All were explainable via recent programmatic changes in the requirements or expected movement between cleared and uncleared career fields. Regardless of whether the requirements greatly exceed supply or vice-versa, targeted assignments were not the solution for these outliers and hence they were excluded from further analysis.

## Methodology

Knowledge of the assignment process confirmed that a small amount of consideration was given to the possession of clearance when filling an authorization, but how much is a 'small amount'? Was it measurable?

Data was separated into four distinct, analytically tractable groups, as shown in Table 3.

	Authorization	Filled by...
(1)	TS	TS
(2)	TS	Non-TS
(3)	Non-TS	TS
(4)	Non-TS	Non-TS

Table 3. Analytically Tractable Groups

The groups of primary interest in this study were (1) Top Secret authorizations filled with Top Secret personnel, (2) Top Secret authorizations filled with non-Top Secret inventory. Our null hypothesis was that Top Secret and non-Top Secret people were placed into Top Secret positions at the same rate.

Let  $TS_{exp}$  be the expected number of Top Secret positions filled by Top Secret inventory (the **expected initial state**)

$$TS_{exp} = \# \text{ of TS positions} \times \frac{\# \text{ of TS cleared people in career field}}{\# \text{ of people in career field}}$$

Also, let  $TS$  be the number of people in a career field who initially had a Top Secret clearance. The resulting hypotheses were as follows:

$$\begin{aligned} H_0: TS &= TS_{exp} \\ H_a: TS &> TS_{exp} \end{aligned}$$

Although  $TS_{exp}$  was very simple to calculate,  $TS$  could not be measured directly. The only data available was present assignments along with current clearance held. The clearance that a person held when they started a particular assignment was unknown. As a result two proxies for  $TS$  were used, which were called the observed current state and constructed initial state.

The **observed current state** ( $TS_{obs}$ ) was what was observed in the data--the number of Top Secret cleared people that were currently working in Top Secret jobs. The problem with  $TS_{obs}$  was that some people working in Top Secret positions started their assignment without a clearance and had since received their clearance. That is,  $TS_{obs} \geq TS$ . Hence, if the more powerful test

$$\begin{aligned} H_0: TS_{obs} &= TS_{exp} \\ H_a: TS_{obs} &> TS_{exp} \end{aligned}$$

is computed, and the null hypothesis is unable to be rejected, then there is no hope of rejecting the original null hypothesis  $TS = TS_{exp}$ . However, if the null hypothesis is rejected, it tells nothing about the original test.

As a result of these difficulties, an estimate of  $TS$  was constructed and was called the **constructed initial state** ( $TS_{init}$ ). The assumptions were as follows:

1. All assignments were three years in length.

2. At any time within any AFSC, there were equal numbers of people in their first, second and third year of the assignment.
  3. All uncleared personnel placed in cleared positions applied for a Top Secret clearance at the beginning of their tour.
  4. All clearance applications were approved by the second year.
- A notional example in Table 4 demonstrates the calculations involved.

Filled by:	Observed Current State	Constructed Initial State
Non-TS Inventory	20	30
Top Secret Inventory	80 ( $TS_{obs}$ )	70 ( $TS_{init}$ )

Table 4. Notional Example for 100 Top Secret Authorizations

This can also be expressed algebraically as shown in Table 5. Let  $N$  be the number of initially uncleared personnel working in a Top Secret position in each year of assignment and let  $C$  be the initially cleared personnel in Top Secret authorizations in each year of assignment.

Algebraic Expression of Authorizations		
Filled by:	Observed Current State	Constructed Initial State
Non-TS Inventory	$2N$	$3N$
Top Secret Inventory	$3C + N$	$3C$

Table 5. Algebraic Expression of Authorizations

Two statistical tests were performed.

Observed Current State

$$H_0: TS_{obs} = TS_{exp}$$

$$H_a: TS_{obs} > TS_{exp}$$

Constructed Initial State

$$H_0: TS_{init} = TS_{exp}$$

$$H_a: TS_{init} > TS_{exp}$$

### Statistical Tests

To test the hypotheses set up in the previous section, a chi-squared test was performed to test preferential placement both within each career field and over all AFSCs.

This test was chosen because there existed categorical data with very large cell counts within these groups (usually more than 100). Let  $TS_{obs}$ ,  $TS_{exp}$ , and  $TS_{init}$  be the observed, expected and constructed initial numbers of Top Secret personnel in Top Secret jobs, and the  $S_{obs}$ ,  $S_{exp}$ , and  $S_{init}$  be the observed, expected and constructed initial numbers of non-Top Secret personnel in Top Secret jobs.

For each AFSC, the tests had the following form with one degree of freedom:

Observed vs. Expected

$$\chi^2 = \frac{[TS_{obs} - TS_{exp}]^2}{TS_{exp}} + \frac{[S_{obs} - S_{exp}]^2}{S_{exp}}$$

### Constructed Initial vs. Expected

$$\chi^2 = \frac{[TS_{init} - TS_{exp}]^2}{TS_{exp}} + \frac{[S_{init} - S_{exp}]^2}{S_{exp}}$$

To test if there was preferential placement over all AFSCs, a Wilcoxon Signed-Rank test was used. A Wilcoxon Signed-Rank test was chosen because the data presented were not normal and there were a relatively small number of AFSCs in our regions of interest.

For all statistical tests a one-tailed test with an alpha value of  $\alpha=.05$  was used.

### Analysis

As a graphical illustration of the statistical tests is given in Figure 6.

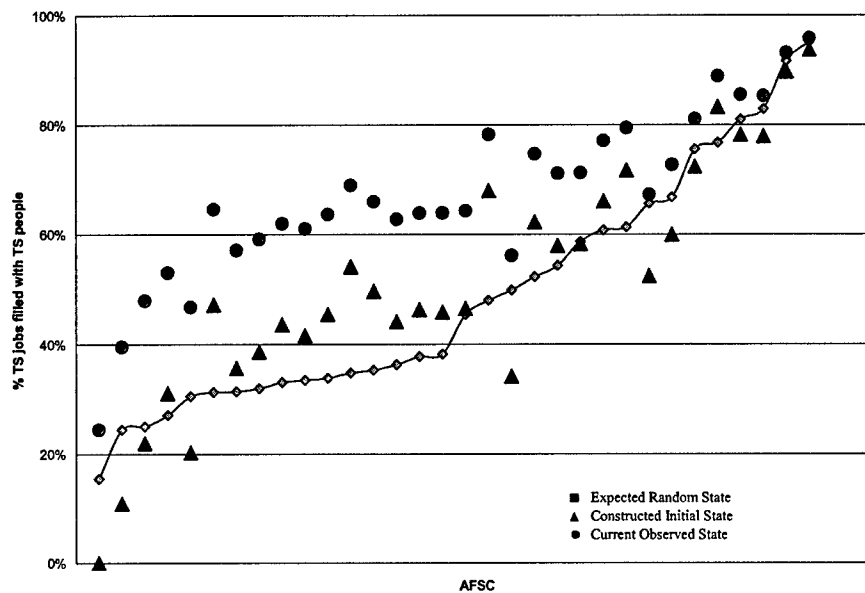


Figure 6. Observed vs. Expected TS Fill Rate

From the graph it was already obvious that in general  $TS_{obs} > TS_{exp}$ , although the relationship between the constructed initial state and the expected random state was not so easily discernable.

The results of the statistical tests at the individual AFSC level showed that all but five AFSCs show a statistically significant difference between the observed current state and the expected random state. The constructed initial state, however, was indistinguishable from the expected random state in about half of the career fields. For results at the individual AFSC level, see Appendix B.

The more important results for this study are the conclusions that can be drawn. The overall results show that when testing the observed current state, the null hypothesis may be rejected, although when testing the constructed initial state, the null was unable to be rejected. That is, the data strongly shows that current placement in positions is

somewhat dependent on clearance status, however initial placement into those positions is not related to clearance status. Therefore, since there is no discernable difference between the initial placement and random placement (with respect to clearance held) there are potential gains to be made by preferentially placing cleared people into cleared jobs.

### **Potential Savings**

Statistical analysis showed potential for gains with targeted assignments in 32 AFSCs. Other career fields were either too small or required too few or many clearances to target assignments. This study proposed four options to save money and increase productivity. Three options related to targeted assignments and the fourth option proposed a programmatic change in assignment duration for Top Secret positions.

Option 1 (0:1) - Never place an uncleared person into a cleared position (hence triggering an investigation) when there is a cleared person available in that career field. This not a practical option since movement between cleared and uncleared positions is necessary for career advancement and broadening. This case will, however, give us an upper bound on the potential savings of the targeted assignments. It would provide a savings of 2,300 clearance applications and \$6.8 million the first year. Savings in subsequent years would be reduced and eventually approach some smaller fixed annual amount that would be dependent on retention rates and other factors not modeled.

Option 2 (1:3) - Place uncleared people into cleared positions at a ratio of 1:3 (e.g. if 4 Top Secret positions are available then 1 will be filled with an uncleared person and 3 filled with cleared people). This is a slightly less strict proposal for targeted assignments and would allow for some movement between cleared and uncleared positions. It would reduce the number of new clearance applications by 1,300 and save \$3.8 million the first year, with reduced savings thereafter.

Option 3 (2:3) - Place uncleared people into cleared positions at a rate of 2:3 (e.g. if there are 5 Top Secret positions, 2 will be filled with uncleared people and 3 with cleared people). Option 3 is very similar in nature and implementation to Option 2, although it is less strict in terms of allowing a higher percentage of cleared personnel to take non-cleared positions. This option would reduce the number of new clearance applications by 520 and save \$1.5 million.

Option 4: A tangential programmatic solution to the clearance backlog was also briefly examined - extend assignment length for top secret authorizations from three to four years. This increase in assignment length would allow for better utilization of those individuals who had to initially apply for a Top Secret clearance. The reduction of new applicants would equate to a 25% reduction of applicants for a Top Secret clearance and 25% reduction of non-Top Secret individuals working in Top Secret authorizations. This total savings equals \$4.5 million the first year.

The savings described above are not sufficient to justify the changes that would be required. There are several reasons which became apparent throughout the study which led to unsatisfactory levels of savings:

Targeted assignments are only useful in a small number of AFSCs. Most clearance applications occur in AFSCs not suitable for targeted assignments because all people working in that AFSC require a clearance.

Movement between career fields, which is necessary for career progression, necessarily forces mismatches between the number of personnel in a career field with a clearance and the requirements for authorizations in that field.

The actual expenditures on security clearances (around \$100 million) include the costs of Secret investigations (which are required for nearly all Air Force personnel) and the costs of periodic reinvestigations for Top Secret clearances, which are nearly as costly as an initial Top Secret clearance.

Lengthening tours, although it sounds like a sensible way to reap some rewards in terms of savings, proved inadequate because it would not generate enough savings to both offset the cost of implementing the program and significantly reduce the cost of the Top Secret clearance backlog. The real driver of the cost for security clearances is the requirements. That is, which jobs *really need* a Top Secret cleared person. This question was well outside the scope of this study.

## **Conclusion**

Security clearances are a fact of life in defense. The current backlog of personnel awaiting receipt of a security clearance is long and costs millions each year in lost productivity. Macroscopic analysis suggests that the Air Force currently has a sufficient number of Top Secret cleared personnel to fill their Top Secret requirements, although when looking within career fields there are issues with matching personnel to requirements. Targeting personnel with Top Secret clearances into Top Secret positions is one way to reduce clearance applications, save money and increase productivity. Targeting Top Secret personnel into Top Secret assignments is only practical in the few career fields that are sufficiently large and have the appropriate mix of cleared and uncleared jobs. This focus of the study restricted us to only 32 career fields and was necessary, although it severely limited the potential savings of our solution.

Data limitations did not allow us to look at our preferred study approach of examining career progression and the movement between cleared and uncleared positions over time. Instead the study was limited to a snapshot of authorizations and the personnel matched to them. To determine the viability of preferential placement of personnel based on clearance status, it was first necessary to determine to what degree that occurs presently. This was accomplished with statistical tests where a proxy was tested for initial clearance status against the distribution expected if assignments were random with respect to security clearances.

The statistical tests showed that, although the present distribution of Top Secret cleared people in Top Secret positions was not random, it could not be proven that there was preference given at the time of initial placement into those positions. Given the potential of those results, the savings associated with the preferential assignment process was explored, but with disappointing results. Within the few career fields to which the study was limited, the potential savings are minimal compared to the cost of the measures that would need to be taken.

In conclusion, at first glance preferential assignments based on clearance status appeared promising, but in reality the savings were extremely limited. Therefore, it was the conclusion of this study that actively prioritizing Top Secret clearance positions in the personnel system does not benefit the security clearance backlog.

## **Appendix A**

<b>Officers</b>	
11H	Helicopter Pilot
11M	Mobility Pilot
12M	Mobility Navigator
13M	Airfield Operations
16P	International Politics - Military Affairs
21A	Aircraft Maintenance
21B	Maintenance
21M	Munitions and Missile Maintenance
21R	Logistics Readiness
30C	Support Commander
31P	Security Forces
33S	Communications and Information Systems
35P	Public Affairs
38M	Manpower
51J	Judge Advocate
61S	Scientific/Research
62E	Developmental Engineering
63A	Acquisition Manager
64P	Contracting
65F	Financial Management

<b>Enlisted</b>	
1A1	Flight Engineer
1A4	Airborne Battle Management Systems
1C6	Space Systems Operations
1W0	Weather Forecaster
2E1	Meteorological and Navigation Systems
2G0	Logistics Plans
2M0	Missile and Space Systems Electronics Maintenance
3A0	Information Management
3C1	Radio Communication Systems
3C3	Computer Systems Planning and Implementation
3E8	Explosive Ordinance Disposal
3V0	Visual Information

## Appendix B

Results of statistical tests over all AFSCs. Wilcoxon Signed Rank Test.

	Actual vs. Predicted			Initial vs. Expected		
	T-Statistic	Sample Size	Reject if T-is less than	T-Statistic	Sample Size	Reject if T-is less than
Officers	0	20	60	68	20	16
Enlisted	0	12	17	28	12	17

Results of statistical test at the individual AFSC level. Chi-square test with 1 d.f.

	AFSC	Actual vs Predicted		Initial vs Predicted	
		ChiSq	P-Value	ChiSq	P-Value
Officers	11H	3.58	0.06	22.38	1.00
	11M	321.96	0.00	63.78	0.00
	12M	26.35	0.00	7.62	0.01
	13M	20.99	0.00	0.38	0.46
	16P	0.13	0.72	0.50	0.52
	21A	29.56	0.00	11.88	1.00
	21B	4.96	0.03	1.79	0.82
	21M	4.33	0.04	2.92	0.91
	21R	134.28	0.00	11.79	0.00
	30C	0.46	0.50	0.79	0.63
	31P	60.77	0.00	0.25	0.62
	33S	56.50	0.00	5.34	0.98
	35P	38.87	0.00	2.36	0.12
	38M	26.08	0.00	3.95	0.05
	51J	118.03	0.00	16.45	0.00
	61S	31.35	0.00	0.46	0.50
	62E	146.57	0.00	11.01	0.00
	63A	163.18	0.00	18.01	0.00
	64P	43.74	0.00	3.81	0.05
	65F	66.14	0.00	15.40	0.00
Enlisted	1A1	98.66	0.00	8.43	0.00
	1A4	27.13	0.00	17.62	1.00
	1C6	185.67	0.00	82.01	0.00
	1W0	55.62	0.00	423.76	1.00
	2E1	440.25	0.00	15.24	0.00
	2G0	40.75	0.00	1.13	0.29
	2M0	325.78	0.00	134.76	0.00
	3A0	977.38	0.00	317.17	0.00
	3C1	3.39	0.07	27.40	1.00
	3C3	63.67	0.00	14.41	0.00
	3E8	2.83	0.09	10.27	1.00
	3V0	81.65	0.00	9.36	0.00

### **Appendix C: Acronymns**

AFSC	Air Force Specialty Code
AFSC3	First three digits of the Air Force Specialty Code
AFSAA	Air Force Studies and Analyses Agency
MILPDS	Military Personnel Data System
TS	Top Secret
UMD	Unit Manning Document

### **Descriptors:**

Security Clearance  
Top Secret  
Investigation  
Chi-squared Test  
Wilcoxon Signed-Rank Test  
Backlog  
Personnel  
Assignments